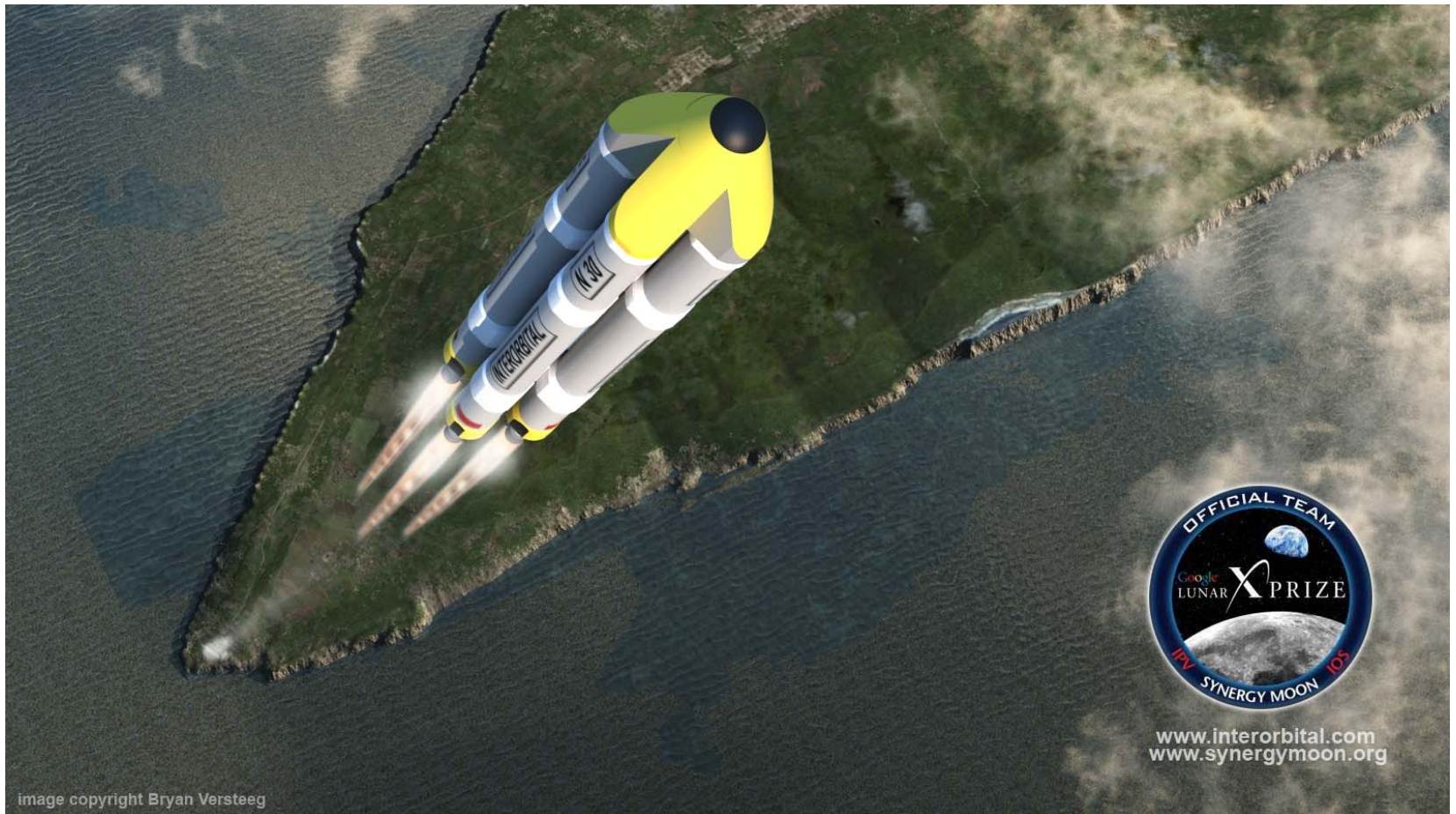


WWW.INTERORBITAL.COM

Interorbital Systems' Dedicated, Non-RideShare, and Co-Manifested TubeSat/CubeSat Launch Programs



Interorbital Systems
www.interorbital.com



About Interorbital Systems



- **Founded in 1996**
- **End-to-end R&D and manufacturing facilities**
- **Two operational rocket engine test sites**
- **Location: Mojave Spaceport in California**
- **Launch Operations (land): IOS' private spaceport, Kingdom of Tonga**
- **Launch Operations (ocean): Worldwide**



Interorbital Systems

www.interorbital.com



Pressure-Fed Rocket Engines

GPRE 2.5KLMA Liquid Oxygen/Methanol Engine: Thrust = 2,500 lbs.

GPRE 0.5KNFA WFNA/Furfuryl Alcohol (Hypergolic): Thrust = 500 lbs.

GPRE 0.5KNHXA WFNA/Turpentine (Hypergolic): Thrust = 500 lbs.

GPRE 3.0KNFA WFNA/Furfuryl Alcohol (Hypergolic): Thrust = 3,000 lbs.

GPRE 6.0KNHXA WFNA/Turpentine (Hypergolic): Thrust = 6,000 lbs.

GPRE 10.0KNHXA WFNA/Turpentine (Hypergolic): Thrust = 10,000 lbs.



Pressure-Fed Sounding Rockets

Neutrino: GPRE 0.5NFA Engine

Tachyon: GPRE 3.0KNHXA Engine

CPMTV: GPRE 6.0NHXA Engine

CPM SR45: GPRE 6.0NHXA Engine

Manned Systems

Dick Rutan's Global Hilton Project

Helium/Hot Air Balloon System Propane Tanks





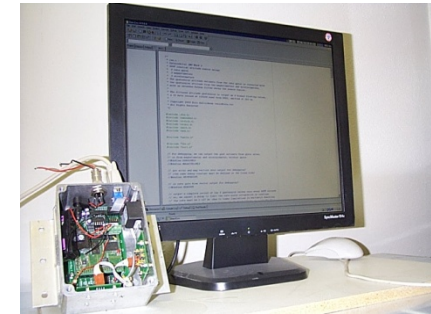
Key Rocket Hardware Built In-House



Advanced Composites including state-of-the-art lightweight propellant tanks



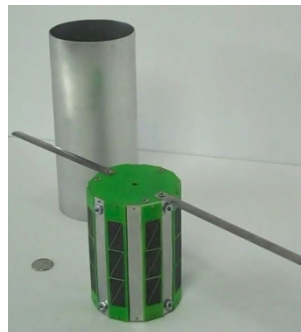
Ablative Rocket Engines and Components



Advanced Guidance Hardware and Software



Modular Rocket Components



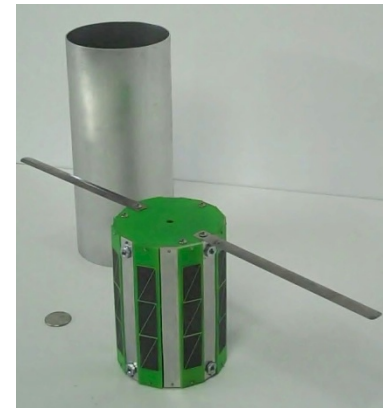
Small Satellites: TubeSat Kit



Rocket Injectors, Valves Systems, and other Metal Components

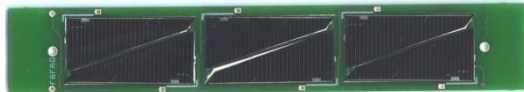


- A rounded hexadecagonal form-factor
- Assembled primarily from printed circuit boards (PCBs)
- The satellite's system PCBs are stacked and separated by standoffs
- 8 Solar Cell PCBs and 8 aluminum radiator strips form the outer shell
- Dipole antenna
- Diameter = 8.9 cm (3.5 in) Length = 12.7 cm (5 in)
- Mass = 0.75 kg (1.65 lb)
- Experiment or Application mass = 250 g (0.55 lb)

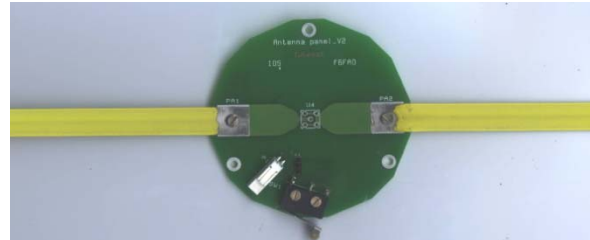


TubeSat with Sample Ejection Cylinder

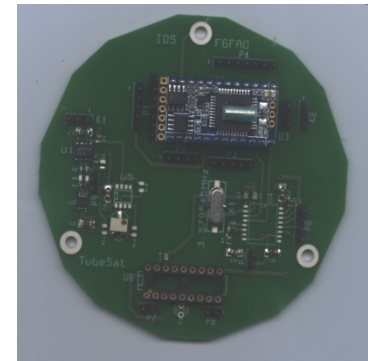
Solar Cell PCB



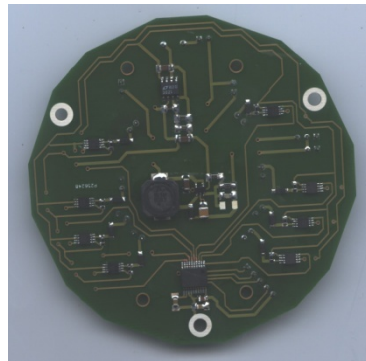
Antenna PCB



Microcontroller PCB



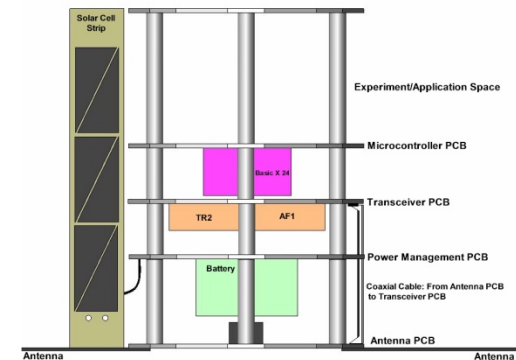
Power Management PCB



Transceiver PCB



TubeSat Component Layout





- **PCB Gerber Files**
- **50 Spectrolab TASC solar cells**
- **A Transceiver (Radiometrix or Microhard n920F or n2420F)**
- **A Li-ion battery pack (3.7 V 5200 mAh)**
- **Microcomputer (NetMedia BasicX-24)**
- **Antennas**
- **Fasteners**
- **Complete instructions**

The IOS TubeSat kit also includes a launch to a 310-km circular polar orbit on the IOS N45 rocket!



Environmentally Safe, Storable, High-Density Hypergolic Propellants

White Fuming Nitric Acid (WFNA) and Turpentine/Furfuryl Alcohol
Instantaneous chemical ignition eliminates need for complex ignition system

Low-Cost Propellant Tank Technology

Custom aluminum tank liners and tank ends
State-of-the-art composite tank reinforcement technology

Blowdown Propellant Feed

Eliminates the need for turbopumps or a separate pressurant system

Unique Rocket Engine Injector

Automatically maintains propellant jet flow rate in blowdown mode
Maximizes specific impulse over a wide pressure input range

Differential Throttling and Fluid Injection Rocket Steering Technology

Allows all rocket engines to be fixed
Valves control the rocket attitude
Hold downs are not required

Modular Rocket System – The Common Propulsion Module (CPM)

Low-thrust rocket engines
Low rocket engine development cost
Small diameter tanks; slosh baffles not required
Individual rocket modules can be flight tested at a very low cost
Launch vehicle can be customized for any payload
Assembly-line mass production

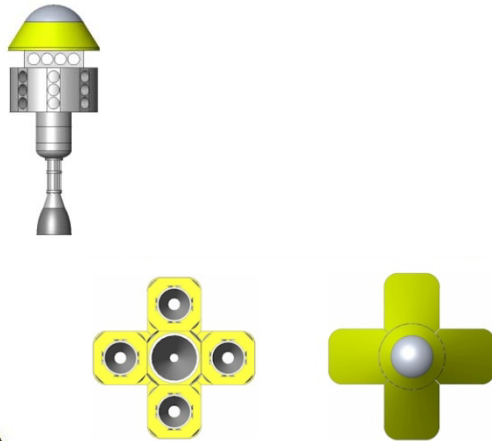
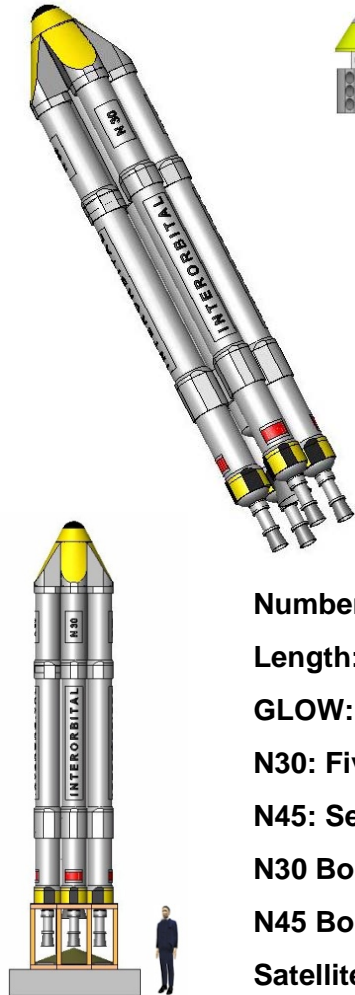




- The Common Propulsion Module (CPM) is the basic building block of the N-Series Rockets
- Bi-propellant storable, hypergolic liquid rocket system
- Blowdown propellant feed
- State-of-the-art composite propellant tanks
- Throttleable, ablatively-cooled rocket engines
- CPMs clustered together in multiples to meet mission requirements

Common Propulsion Module (CPM)





Number of Stages: 3 (parallel and tandem staging)

Length: 31.5 feet (10.3 m); Maximum Diameter: 6.2 feet (1.89 m)

GLOW: 18,700 pounds (8,841 kg)

N30: Five (5) Common Propulsion Modules

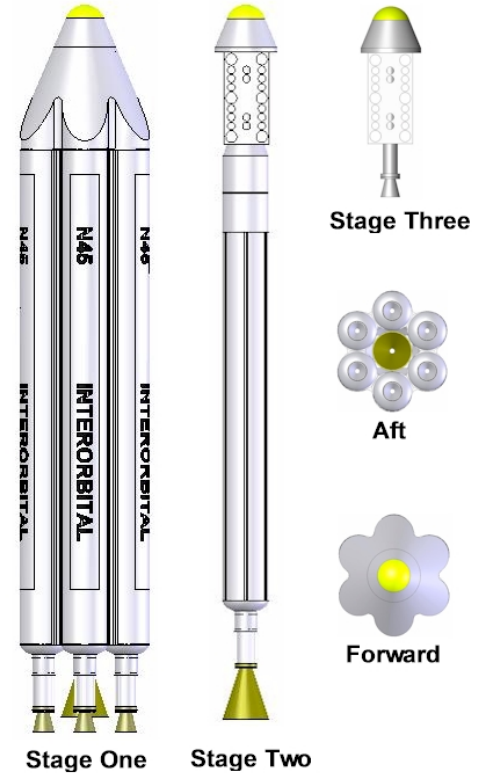
N45: Seven (7) Common Propulsion Modules

N30 Booster Thrust = 4 X 6,000 lbs = 24,000 Lbs SL (106,752 n)

N45 Booster Thrust = 6 X 6000 lbs = 36,000 pounds

Satellite Module includes a liquid or solid kick engine or motor

N30: Payload = 30 kg



N45: Payload = 45 kg



- **Portable, dedicated small sat launchers**
- **Easy to transport on highways, ocean, or by air in standard 40-foot cargo container**
- **Can be launched from land or sea**
- **Launched from land from a Mobile Launch System**
- **Launched from the ocean using the Floating Launch Method**
- **Launch-on-Demand System**
- **Ultra low-cost, rapid access to space**
- **Four low-altitude test flights cleared by FAA for 2010**
- **Three Orbital Missions planned for 2011**



CPM TV: Common Propulsion Module Test Vehicle

- Low-altitude unguided flight (1)
(35,000-50,000 ft)
- Low-altitude with guidance flights (2)
(35,000-50,000 ft)
- Hover test (low altitude) (1)





CPM Mobile Rocket Launcher



- **Hydraulic lift system**
- **Equipped with propellant-fill hardware**
- **A full-service rocket transportation and launch unit**
- **Mobile launch platform for IOS CPM SR45 sounding rocket program**





- **New Vertical Test Stand**
- **Maximum thrust capacity = 12,000 lbs**
- **Rocket plume does not impact ground**





Spaceport Tonga



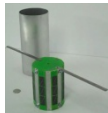


Standard Orbit

Circular Polar

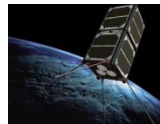
310-km (higher altitudes available)

Estimated 1.5 to 3 month decay to reentry



- **TubeSat Payloads (48)**

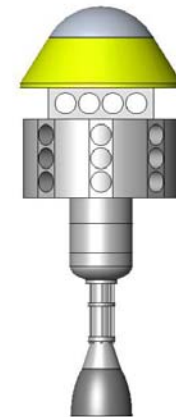
- **CubeSat Payloads (30)**



- **Combined TubeSat and CubeSat Payloads (variable)**

- **Single small satellite (up to 45-kg)**

Max Payload Size: 60 cm X 80 cm (square or round cross section)



Customized orbits are available

End of First Quarter 2011: 32 TubeSats and 10 CubeSats

Orbit: Circular Polar

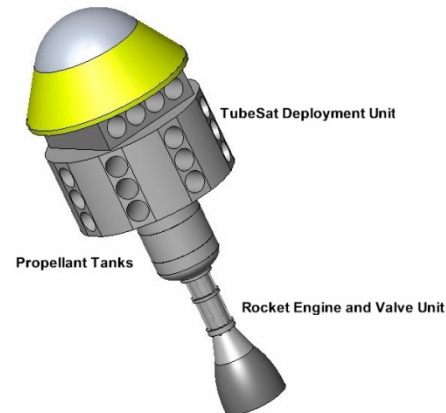
Altitude: 310 km

Second Quarter 2011: 20 CubeSats

Orbit: Circular Polar

Altitude: 620 km

N30 Satellite Module





CubeSats

- UC Irvine
- EuroLuna (2U from Denmark, GLXP Team) MiniRomit 1
- Universidad de Puerto Rico



TubeSats

- Morehead State University (Kentucky)
- InterAmerican University of Puerto Rico
- University of Sydney (Australia)
- Aslan Academy (Private LA High School)
- Project Calliope (Space Music Project)
- SYNERGY MOON (GLXP Team)
- Naval Postgraduate School (3) (Maritime Interdiction)
- Defense Science and Technology Lab (DSTL,UK)
- An unnamed US Military client
- Austrian Arts Group **mur.org**
- United States Military Academy at West Point



▪ 20 additional projects with committed payloads are in various phases of arranging funding. These include academic, arts, private-sector, military, and corporate groups from the US, Peru, Mexico, Germany, Vietnam, Pakistan, Brazil, New Zealand, the Dominican Republic, Holland, and France



Launch Vehicle: NEPTUNE 45 (N45)

Orbit Type: Circular Polar

Orbital Altitude: 310 km

Price List

CubeSat: \$12,500 (launch only)

TubeSat: \$8,000 (basic kit including launch)

Single 45kg Satellite Payload: \$384,000

TubeSat slots available for first orbital mission: 18

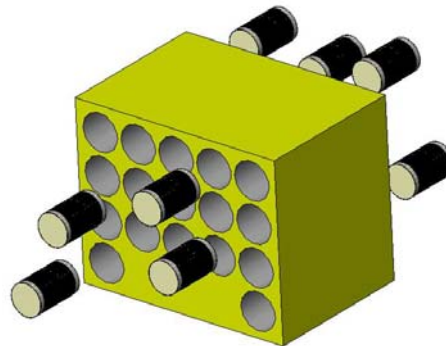
CubeSat slots available: 5



Upcoming 620-km Co-Manifested Mission

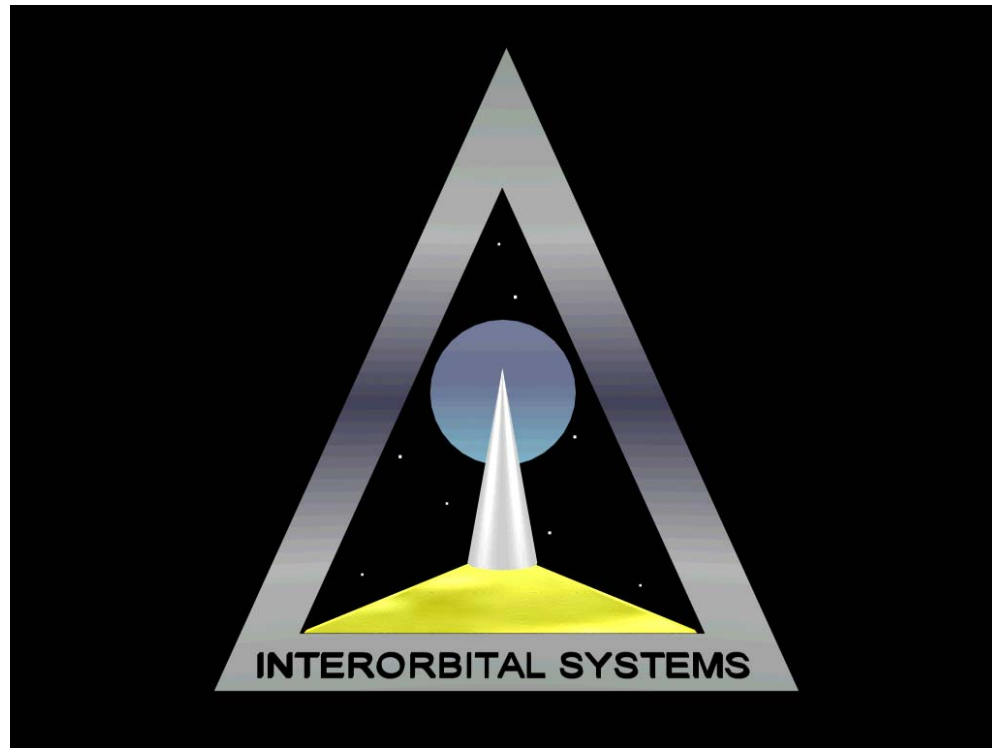


- **CubeSat or TubeSat form-factor**
- **Maximum mass per single satellite unit: 1 kg**
- **Number of units: 12 units (multiple 2U and 3U satellites acceptable)**
- **Price: \$25,000 per satellite (kit cost not included)**
- **Current Manifest:**
University of Sydney has reserved space for a 2U CubeSat



Interorbital Systems

www.interorbital.com



WWW.INTERORBITAL.COM